EXP-21
August 23, 1972

ACCELERATOR EXPERIMENT--Remanent Sextupole Field in the Main Ring

Experimentalists: R. Stiening

Date Performed: July 22, 1972

A series of measurements of the tune (horizontal as well as vertical) have been made by R. Stiening just before the shut-down (July 22, 1972). The main purpose of these measurements was to find the dependence of the tune on momentum so that one can get a reasonably accurate estimate of the remanent sextupole field. Data used in this report are in the log book, Main Ring Experiments 2, pp. 68-89.

Since the vertical tune measurement is easier to interpret than the horizontal one, only the former is used to get the result.

Data

1. 7.24 GeV (p. 89)
   air-core sextupole current 42 Amp
   total number 182
2. 25.6 GeV (p. 83)
   sextupole current 17 Amp
   acceleration 65 GeV/sec
3. 25.6 GeV (p. 75)
   sextupole current 0 and 36.5 Amp
   acceleration 65 GeV/sec

$B_y = (B''/2) \cdot x^2$

At 40A, B" = 19.7G/(inch)^2 for air-core sextupoles. This corresponds to "6G-m/(inch)^2" given by C. Rode. We also know that, for the vertical tune, the effect of B2 dipoles is stronger than that of B1,

$$\frac{\text{effect of B1}}{\text{effect of B2}} = 0.637.$$

(For the horizontal tune, the ratio is 2.15.)

Data 1. 7.24 GeV

$$\xi \equiv 0.637\, B_1''(\text{remanent, B1}) + B_2''(\text{remanent, B2})$$
$$= -1.143\ \text{kG/m}^2 = -.737\ \text{G/(inch)}^2$$

Data 2. 25.6 GeV, 17 Amp, 65 GeV/sec

$$\eta \equiv 0.637\,(B_1'' + b_1'') + (B_2'' + b_2'') = -0.679\ \text{kG/m}^2$$
$$= -0.438\text{G/(inch)}^2$$

where b_1'' and b_2'' are for sextupole fields due to eddy current.

From ξ and η

$$0.637\, b_1'' + b_2'' = 0.464\ \text{kG/m}^2 = 0.299\ \text{G/(inch)}^2$$

This should be compared with a theoretical value

$$(b_1'' = 0.322,\ b_2'' = 0.241)$$
$$0.637\, b_1'' + b_2'' = 0.446\ \text{kG/m}^2.$$

Data 3. 25.6 GeV, 36.5 Amp, 65 GeV/sec

$$\eta = -0.648\ \text{kG/m}^2 = -0.418\ \text{G/(inch)}^2$$

With $\xi = -1.143\ \text{kG/m}^2$,

$$0.637\, b_1'' + b_2'' = 0.495\ \text{kG/m}^2$$

These values are in an excellent agreement with the results from Data 2 (~5%).

We can also compare these results with a measurement of B_1'' and B_2'' (C. Schmidt),

$$B_1'' = -0.636 \text{ kG/m}^2, \quad B_2'' = -0.558 \text{ kG/m}^2$$

$$\xi \equiv 0.637\, B_1'' + B_2'' = -0.963 \text{ kG/m}^2$$

Agreement with the result from Data 1 (-1.143 kG/m^2) is not at all bad.

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